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Technology Transfer and Licensing Activities of ARCH Development
Corporation and the Impact of Federal R&D Technology Transfer Programs on
Universities and Small Business and Related Issues

Written Testimony - Teri F. Willey, ARCH Development Corporation (1)

Federal R&D fuels innovation...and not just in our university laboratories. It fosters innovation in policy, business transactions and academic administration. Perhaps an example of this is ARCH Development Corporation, a wholly owned not-for profit affiliate of the University of Chicago. It was founded, shortly after the passage of the amended Bayh-Dole Act, to create companies and license inventions made at the University of Chicago and Argonne National Laboratories. Since 1986 ARCH has generated 25 million dollars in returns from licensing and new company formation activities. These dollars represent products on the market, businesses and jobs that would not otherwise be available to us. Furthermore, since 1995 ARCH has been self-supporting (that is, we carry-out technology transfer activities for the University of Chicago no cost to them...other than a little grief now and then as a result of our innovative nature.)

In addition to its licensing and start-up activities, ARCH has spawned an early-stage venture capital partnership (ARCH Venture Partners (1)), provided entrepreneurial experience and training to numerous business students and helped to create a unique research-based entrepreneurial center at the University of Chicago Graduate School of Business.

Licensing Inventions and Copyrights

ARCH is a team of experienced business professionals, researchers, academicians and graduate students working together to create an optimal return based on university innovations in science and teaching. Though each project is unique, ARCH uses three main mechanisms to channel early stage ideas into the marketplace:

- “ to an existing company for the purpose of product development. (Royalties and license fees are typically the consideration for these licenses.)
- “ to a company formed by a group other than ARCH. (Equity and royalties are typically the consideration for these licenses.)
- “ to a company ARCH forms. In essence, we create our own licensee. (The license terms are similar to the situations above; however, ARCH also establishes equity in these start-ups as a result of their formation and investment activities.)

In most cases, ARCH makes the decision to start a company when the technology is simply too early to interest an existing company. Furthermore, it is important that the expected value of the returns from equity and royalties from a start-up, less the expected cost of getting to that return, substantially exceed the expected return from licensing to an existing company. Regardless, ARCH won't proceed with company formation unless there is an experienced private sector manager willing to go at risk with ARCH to start the company. Good CEO's and early stage seed funding for our ventures continue to be the top gating factors for the number and quality of projects we can do.

ARCH Smart Starts.

When ARCH forms a company it supports "the management" (sometimes initially

just one employee). This program of support, sometimes called "ARCH Smart Starts" has evolved based on ARCH's experience in doing start-ups over the past decade. It is designed to support the at-risk manager/CEO to assure that they can focus on product development issues. The program includes support in the following areas:

- " Building the business plan and marketing research
- " Incorporation and creation of organizational documents
- " Creation and support of a hard working Boards of Directors
- " Support in finding and closing financing
- " Establishment of accounting and financial management systems
- " Procurement of D&O, business, medical and related insurance
- " Patent strategy and management support
- " Understanding COI and other university policy issues
- " Creation and support of a Scientific Advisory Board
- " Managing inventor relationship issues
- " General office and computer support
- " Creation of documents for, and assistance with, legal transactions

More About ARCH's Start-up Program.

" Early stage seed funding is critical for our companies. SBIR funds have been a useful source when the research funded is on the critical path in product development plan. We've successfully used it in three of our new company projects. Another source of early stage funding has been the Illinois Coalition's state venture fund IDFA (Illinois Development Finance Authority). IDFA matches funding by qualified investors and uses panels of local business experts to quickly review and rule on applications. The decisions are timely and the review panel is a value added step. We encourage an expanded effort on the state level in this regard. IDFA and SBIR funds are an important part of the support mechanism for early stage companies based on university research results.

" When successful, our companies generate returns in the form of royalties and equity. The relationship of equity and royalties in our transactions with

start-up companies creates a balance of long and short-term returns critical to sustaining our efforts. More importantly, when our equity becomes cash long before product sales (as is common with an IPO or acquisition of a biotech company) maintaining a licensee-licensor relationship (and obligation to receive royalties on sales of products) encourages the formation of companies that not only exit well but develop products that reach the public.

- “ To date, close to 50% of the royalties ARCH receives come from products sold by licensees/companies started by ARCH.
- “ To date over 50% of ARCH's total returns have come from equity (compared to 5% for most University technology transfer programs). ARCH receives returns from equity from its start-ups in two ways: 1) cash from common stock obtained as a result of formation activities, and 2) cash from preferred shares as a result of investment from a small "Virtual Venture Fund" (a fund composed of returns from certain classes of equity held by ARCH in it's companies).
- “ ARCH Development Corporation was responsible for starting 18 companies prior to January 1995. Since its reorganization in 1996(1) ARCH has developed a portfolio of 10 start-up projects. Below is a table, which summarizes them. The top five in the list are entities with funding other than ARCH investment. The remaining are projects in various stages of formation and fund raising. All 10 companies/projects below include technologies from universities other than the University of Chicago (or in addition to Argonne National Laboratory.) All companies are based on inventions resulting from federally funded research. Three of the companies have been awarded SBIR funds (including 4 Phase I awards and 2 Phase II awards.)
- “ Under its current structure, ARCH expects to add 3-4 new company projects

resulting in the formation of 1-2 new companies per year (not including licenses to start-ups formed by organizations other than ARCH).

ARCH Portfolio Companies

A sample of a few of our recent portfolio companies.

Xcyte Therapies, Inc. - A cell therapy company focused on developing novel treatments for concern, autoimmune and infectious diseases.

NephRx Corporation - A biotechnology company working to discover and develop novel agents for the treatment, diagnosis and the prevention of kidney disease.

Influx, Inc. - An R&D company developing novel means to combat antibiotic resistant infections.

SmartSignal, Inc. - A software/engineering company commercializing breakthrough pattern recognition, signal surveillance, sensor validation and fault detection technology.

Recommender.com, Inc. - An e-commerce software company.

ClearCut Solutions, Inc. - educational software company.

IMSA Company Project - Company formation to advance revolutionary teaching techniques.

Grier Co. Project - Company formation to advance novel physics research for developing the next generation of gene chips.

Chromosomes Project - Company formation to advance novel vectors for plant transformation.

Sleep Factors Project - Company formation to advance identification and use of novel growth factors released naturally during deep sleep.

ARCH as part of the University Technology Transfer Community

ARCH is part of a growing landscape of university technology licensing and

start-up activity. Academic research, primarily funded by the federal government, is a catalyst to the U.S. economy.

(The following discussion of University technology transfer is included in this report to the U.S. Senate with the cooperation and permission of the Association of University Technology Managers (AUTM) (2))

Products Available because of University Technology Transfer.

In its seventh annual FY 1997 Licensing Survey released this week, AUTM reported an estimate of more than 1,000 products currently on the market that are based on university licensed discoveries. Accordingly to the research of Thursby et. al. (3) these are examples of products, based on inventions, that would not be considered by industry without the intervention of university technology transfer programs.

AUTM conducts an annual Licensing Survey to assess the licensing activity and economic impact of its members' institutions. This commercialization process--often referred to as university or academic "technology transfer"--involves identifying discoveries made in academic research laboratories, patenting them, and licensing the patents to industry to enable their development into commercial products. Analysis of the Survey finds Academic research, primarily funded by the federal government, is a catalyst to the U.S. economy. AUTM estimates that approximately \$30 billion of economic activity and 250,000 jobs each year are attributable to commercializing academic innovation.

Improving our Health

The Survey reports that 70% of the 15,328 active licenses of responding institutions are in the life sciences yielding products and processes that save lives, diagnose disease, and reduce pain and suffering. Examples of technologies and products originating from university discoveries, other than those at the University of Chicago, include:

- Artificial lung surfactant for use with newborns, University of California
- Cisplatin and carboplatin cancer therapeutics, Michigan State University
- Citracal® calcium supplement, University of Texas Southwestern Medical Center
- Creatine-kinase antibody used in diagnosing heart disease, Washington University
- Haemophilus B conjugate vaccine, University of Rochester
- Hepatitis B vaccine, University of California and University of Washington
- Human growth hormone (genetically engineered), City of Hope Medical Center
- Leustatin® chemotherapy for hairy cell leukemia, Brigham Young University
- Metal Alkoxide Process for taxol production, Florida State University
- Neupogen® used in conjunction with chemotherapy, Memorial Sloan Kettering
- Osteomark® osteoporosis diagnostic, University of Washington
- Prostate-specific antigen test, HRI/Roswell Park Cancer Institute
- rDNA technology, central to biotechnology industry, Stanford and U. of California
- Recombinant engineering co-transformation process, Columbia University
- Retin-A, University of Pennsylvania
- Synthetic penicillin, Massachusetts Institute of Technology
- TRUSOPT® (dorzolamide) ophthalmic drop used for glaucoma, University of Florida

- Vitamin D, University of Wisconsin

Creating Industries and Jobs

Technologies licensed from academia have been instrumental in spawning entire new industries, improving the productivity and competitiveness of companies, and creating new companies and jobs. Research at the University of Pennsylvania in the 1940's resulted in ENIAC, the first electronic calculator and forerunner of today's computers. Today's telecommunications industry relies on laser and fiber optic research done at the Massachusetts Institute of Technology in the 1960's and 1970's. The biotechnology industry is based on recombinant DNA research done at Stanford University and the University of California in the 1970's. The Internet and its burgeoning commercial activity comes largely from research in supercomputing at the University of Illinois in the 1980's.

'40's	<i>electronic calculator</i>	<i>Penn</i>	<i>Computers</i>
'60's	<i>Fiber Optics</i>	<i>MIT</i>	<i>Telecommunications</i>
'70's	<i>rDNA</i>	<i>Stanford Univ. of California</i>	<i>Biotechnology</i>
'80's	<i>Supercomputing</i>	<i>Univ. of Illinois</i>	<i>Internet</i>

More recently, improved data compression technologies discovered at Iowa State University and now used in fax machines, and faster modems for data communication developed at the University of Maryland have changed the way we do business. The atomic force microscope (AFM) offered breakthrough technology developed at the University of California, making it possible to visualize dynamic events in living cells. A new internet search engine developed at Carnegie Mellon University was the basis for Lycos, Inc. Improved methods for sequencing DNA developed at the California Institute of Technology is a basic enabling technology for the Human Genome Project.

Starting New Businesses

Basic science discoveries at academic institutions are often too embryonic for commercialization by large companies. Increasingly, universities are looking to the creation of new businesses to further develop and incubate technologies for the marketplace. In FY97, 333 new businesses were started to move new discoveries from the laboratory to the marketplace, an increase of 34% from FY96. The vast majority of these new spin-off companies, 83%, locate in the region in which the technology was discovered. Since 1980, 2,214 new entrepreneurial ventures have been created to commercialize university technologies. Of these, nearly half, 1,045 have been formed in the past four years.

FY97 Licenses

12% to Startups
47% to Small Companies
41% to Large Companies

Small businesses, companies with fewer than 500 employees, are the principal commercializing partners for university technologies. In FY97, academic institutions signed 3,328 new licenses and options with industrial companies (up 21% in FY96). Fifty-nine percent of these licenses and options were granted to small companies.

Partnering With Industry

Academic institutions forge collaborations with industry to help move research results from the laboratory to the marketplace. Royalties received by institutions

clearly show the success of university-industry partnerships in turning university research into useful products. In FY97, academic institutions received \$611 million in royalties and fees (up 19% from FY96) from 6,974 active licenses. Income from technology transfer licensing is small, percentage-wise, when compared with universities' overall research budgets. While revenues derived from university licensing help to underwrite expenses related to the patenting and licensing of university discoveries, universities reinvest the major portion of their licensing revenues into teaching and research activities.

Remaining on the Cutting Edge

Three major studies issued in 1998 attest to the importance of continuing to support academic research and encouraging university-industry relationships.

The General Accounting Office observed in its May 1998 report to Congress on the effect of the Bayh-Dole legislation that universities are fulfilling their obligations and promises under the Bayh-Dole Act of 1980 (P.L. 96-517). This Act reformed U.S. patent policy related to government-funded inventions, providing incentive for universities and nonprofit research institutions to patent and to find commercial partners to further develop university patents through the technology transfer process.

A recent report authored by Vernon Ehlers of the House Committee on Science strongly recommends continued commitment by the federal government to funding America's academic research enterprise. The Ehlers report confirms that university-industry collaborations help academic institutions attract high quality faculty. They also provide opportunities for faculty and students to interact with industry and encourage universities to offer educational programs attuned to the needs of industry and the Nation. This report makes a number of recommendations in support of sustained federal funding for fundamental scientific research in academia.

A recent study funded by the National Science Foundation determined that 73% of the applicants for U.S. patents listed academic research as part or all of the foundation upon which their new discoveries were based.

Data from the AUTM Survey also attest to the role that academic research plays in innovation. In FY97 alone, faculty reported 11,303 new discoveries from their research activities, up 11% from 10,178 in FY96. Four thousand two hundred sixty seven (4,267) patent applications were filed on these discoveries.

The executive summary of the AUTM Survey, a summary of the Bayh-Dole Act and questions and answers about university technology transfers are attached as background information as reference to this testimony. These materials are provided with the cooperation and permission of AUTM.

Barriers to the Commercialization of University Innovations

We've come a long way since the Bayh/Dole Act was passed. And have made incredible progress considering the complexity of the technology licensing field. Markets are in flux; industries are re-aligning; companies are downsizing/reorganizing; patent legislation is increasing; federal funding is more competitive; conflict-of-interest issues loom; litigation based on transactions generated by academe is more prevalent; international interest and collaborations continue to grow; multiple entities per deal are more common; public scrutiny of our activities is greater than ever, and the demand for the service of academic licensing professionals is increasing, while the resource available to the job are not. The courage to embrace this complexity yield the success reported above.

Lessons Learned

These results represent real accomplishment. Nevertheless, ARCH and other

university technology transfer programs clearly have the capacity to be much more successful. The continuing dearth of gap funding, seed- and early-stage venture capital in the Midwest coupled with the growing demand for creation of spin-out companies as vehicles for commercialization of research results, presents an opportunity for ARCH to share what it has learned and perhaps even expand its company formation operations. We expect to rise to this challenge and in doing so will rely on the lessons learned in our "laboratory" over the last decade or so include:

1. Start with excellent science and teaching. Federally funding provides the foundation for this.
2. The Bayh-Dole Act works. Any changes to it should be thoughtfully considered and any exceptions, exceptional.
3. Remember that we are working at the interface of a profit and not-for-profit system. Understand, appreciate and use both systems. Diminish neither.
4. Capture a fair return on the assets entrusted to us. It is irresponsible not to. Especially since the returns are used to further fuel a system which creates benefits to the public.
5. Conflicts of interest are to be managed, not eliminated. This is a complex issue. Embrace the complexity.
6. Align incentives. When it's good for one stakeholder it should be good for all stakeholders.
7. Appreciate your courageous academic administrators and technology transfer professionals. Transaction and organizational innovation often makes their jobs riskier and painfully more complex.
8. Availability of pre-business plan seed funding is critical to the on-going success of science-based new venture creation and the corresponding economic impact.

(1) ARCH Development Corporation (ARCH) is a non-profit wholly owned affiliate of the University of Chicago founded in 1986 on the recommendation of a task force from the University. Shortly after its founding, ARCH Development Corporation established ARCH Venture Fund I; a venture capital limited partnership. This fund raised \$9 million from the University and other investors. In 1994, the Board concluded that the next fund would be larger and thus would require investment from a broader investment constituency, than an exclusive focus on the University and Laboratory would accommodate. Accordingly, Arch Venture Partners (AVP) spun out from ARCH Development Corporation and raised a second fund of over \$30 million. AVP now has offices at several universities and federal laboratories, and over 140 million dollars under management. AVP continues as part of the network that ARCH uses to recruit seed-stage CEO's for its start-up companies. For more information about AVP see . For more information about ARCH Development Corporation see <http://arch.uchicago.edu> or contact ARCH Development Corporation, 5640 South Ellis, Suite 405, Chicago, IL 60637, phone 773/702-1692, fax: 773/702-0741.

(2) AUTM is a nonprofit association of professionals who manage intellectual property resulting from research at universities, nonprofit research institutions, and teaching hospitals worldwide. Currently, AUTM's membership includes approximately 2,000 professionals working in 275 academic institutions and in companies, the professional services industry, and government. The Survey is available printed in summary or full report form. To order publications visit AUTM's web site at <http://autm.rice.edu/autm> (see AUTM Publications, Survey and Statistics) or contact AUTM Headquarters: 49 East Avenue, Norwalk, CT 06851-3919, phone 203/845-9015, fax: 203/847-1304, e-mail: .

(3) Thursby, Jerry G. and Sukanya Kemp, "Growth and Productive Efficiency of University Intellectual Property Licensing," August 1998, Krannert School of Management, Purdue University; and Jensen, Richard and Marie Thursby, "Proofs and Prototypes for Sale: The Tale of University Licensing," August 1998, National Bureau of Economic Research Working Paper No. 6698.

Attachment #1 - Executive Summary Fiscal Year 1997 AUTM Survey

This publication marks the seventh year for which the Association of University Technology Managers (AUTM) has collected data on licensing activities from its academic constituency, including data from U.S. universities, hospitals, nonprofit research institutions, and patent management firms as well as from Canadian institutions. As may be seen in the reported data, Fiscal Year 1997 results show continued growth in activity across essentially all parameters surveyed, reflecting the sustained effort of academic institutions to license the rights to their inventions to the commercial sector. This effort by both industry and academia brings forth the benefits of these innovations to business through commercialization and to the public through use of the resulting products/processes. Highlights of this year's survey results are provided, in most cases in comparison to FY 1996 or previous survey data.

Key findings are as follows:

- 175 U.S. and Canadian universities, teaching hospitals, research institutes, and patent commercialization companies responded to the Survey.

Research Expenditures:

- Total FY 1997 sponsored research expenditures by the institutions were \$22.7 billion, compared to \$21.4 billion in FY 1996.
- Total FY 1997 sponsored research expenditures funded by federal government sources was \$14.6 billion, up from \$13.9 billion reported in FY 1996.
- Total FY 1997 sponsored research expenditures funded by industry was \$2.2 billion, compared to \$1.9 billion in FY 1996.

Patent-Related Activity:

- 11,303 Invention Disclosures were reported in FY 1997, up 11%¹ from the prior year.
- 4,267 New U.S. Patent Applications were filed in FY 1997, up 31% from 3,261 in FY 1996.
- 2,645 U.S. Patents Issued in FY 1997, up by 26% from FY 1996, bringing total number of U.S. Patents Issued reported in the Survey to 10,050 over the past five years.

Start-Up Activity:

- 333 start-up companies were formed in FY 1997, up 34% from 248 in FY 1996. Of these, 83% were reported to have their primary place of business in the licensor's home state.

- Academic institutions received an equity interest in 251 transactions in FY 1997, up 50% from 167 in FY 1996.
- 2,214 new companies have been formed since 1980 that were based on a license to an academic invention, including the 333 formed in FY 1997.
- In FY 1997 academic institutions received \$22.4 million from liquidation of equity that was received as part of licensing transactions.

Licenses and Options:

- 3,328 new licenses and options were executed in FY 1997, up 21% from 2,741 in FY 1996.
- 59% of new licenses and options executed were with newly formed or existing small companies (fewer than 500 employees), while 41% were with large companies. This compares to 64% and 36%, respectively, reported in FY 1996.
- In FY 1997, 70% of active licenses/options were reported in life science while 30% were related to physical science. This compares to 67% and 33%, respectively, reported in FY 1996.
- In FY 1997, 53% of new licenses and options executed were exclusive, while 47% were non-exclusive, reflecting the same rates that were reported in FY 1996 for these categories.

License Income:

- Total gross income received from licenses and options was \$698.5 million, up 18% from \$591.7 million in FY 1996. (It should be noted that a significant percentage of this income is reinvested in the institutions by policy.)
- Licenses/Options yielding income were 6,974 in FY 1997, up 13% from 6,163 in FY 1996.
- Of the FY 1997 total, \$478.5 million (69%) came from royalties on product sales, \$22.4 million (3%) came from equity liquidation, \$85.9 million (12%) came from various fees and other pre-commercialization payments, and the remainder of \$111.7 million (16%) was not classified according to these categories.
- In FY 1997, 87% of gross license income was from inventions relating to life science while 13% was received from inventions relating to physical science, compared to 86% and 14%, respectively, in FY 1996.
- \$87.0 million of total income was paid to other reporting institutions, up 12% from \$77.7 million in FY 1996, so that net license income was \$611.5 million, up 19% from \$514 million in FY 1996.

Economic Growth:

- 15,328 licenses and options were active in FY 1997, implying that the licensee was still actively developing the invention or selling product, up 18% from 12,951 in

FY 1996.

- An economic impact model developed by AUTM shows that, in FY 1997, \$28.7 billion of U.S. economic activity can be attributed to the results of academic licensing, supporting 245,930 jobs. In FY 1996, the comparable figures were \$24.8 billion and 212,500 jobs.

Attachment # 2 - Bayh-Dole Act Summary

THE BAYH-DOLE ACT

The Bayh-Dole Act (P.L. 96-517, Patent and Trademark Act Amendments of 1980) created a uniform patent policy among the many federal agencies that fund research, enabling small businesses and non-profit organizations, including universities, to retain title to inventions made under federally-funded research programs. This legislation was co-sponsored by Senators Birch Bayh of Indiana and Robert Dole of Kansas and was enacted on December 12, 1980.

Some of the major provisions of the Act include:

Non-profits, including universities and small businesses may elect to retain title to innovations developed under federally funded research programs.

Universities are encouraged to collaborate with commercial concerns to promote the utilization of inventions arising from federal funding:

Universities are expected to file patents on inventions they elect to own;

Universities are expected to give licensing preference to small businesses;

The government retains a non-exclusive license to practice the patent throughout the world; and,

The government retains march-in rights.

- * The Act encouraged universities to participate in technology transfer activities. Prior to Bayh-Dole, fewer than 250 patents were issued to universities each year. In the past few years, U.S. universities

participating in the Survey have averaged almost 1,500 patents annually.

- * There are now more than 200 universities engaged in technology transfer, eight times more than in 1980, as evidenced by the membership of AUTM.
- * Technology transfer -- specifically the licensing of innovations -- adds more than \$21 billion to the economy and supports 180,000 jobs each year. It has helped to spawn new businesses, create industries and open new markets.
- * Furthermore, a 120% in U.S. patent applications and a 68% increase in licenses from FY 1991-1995 indicate that the transfer of technology from academic institutions to the private sector will continue to grow in the next decade, generating future economic growth and health benefits.

Attachment #3

Common Questions & Answers About Technology Transfer

What is technology transfer?

Technology transfer is a term used to describe a formal transferring of new discoveries and innovations resulting from scientific research conducted at universities to the commercial sector. One way that universities transfer technology is through patenting and licensing new innovations. The major steps in this process include: 1) the disclosure of innovations; 2) patenting the innovation concurrent with publication of scientific research; and, 3) licensing the rights to innovations to industry for commercial development.

Prior to 1980, fewer than 250 patents were issued to U.S. universities each year and discoveries were often not commercialized for the public's benefit. Today, U.S. universities participating in the Survey are issued an average of almost 1,500 patents per year. Moreover, there are now more than 200 universities engaged in technology transfer, eight times more than in 1980, as evidenced by the membership of AUTM.

Why has there been such a growth in technology transfer programs?

This success in university technology transfer -- and the resulting economic and

health benefits -- is the direct result of the 1980 Bayh-Dole Act. This legislation, co-sponsored by Senators Birch Bayh and Robert Dole, enabled universities; nonprofit research institutions and small businesses to own and patent inventions developed under federally-funded research programs. The Act provides an incentive for universities to market their innovations and for industry to make high-risk investments.

Has technology transfer improved?

Universities also have seen a significant increase in patent-related activity, demonstrating that new discoveries are moving more actively through the pipeline from the lab to the market. Between FY 1991 and FY 1995, invention disclosures increased by 29 percent, new patent applications increased by 53 percent and licenses and options executed increased by 66 percent.

The Survey data also show that transferring new discoveries is becoming more cost-effective. In FY 1991, 8.5 million total sponsored research expenditures were invested per new patent application. This amount decreased by 18 percent in FY 1995 to 7.2 million total sponsored research expenditures per new patent application.

Total sponsored research expenditures per licenses and options executed followed a similar trend. In FY 1991, 10.4 million total sponsored research expenditures were invested per license and option executed compared to 8.1 million per licenses and options executed in FY 1995.

What are the benefits of improved technology transfer?

University technology transfer -- specifically the licensing of innovations -- adds more than \$21 billion to the economy and supports 180,000 jobs each year. It has helped to spawn new businesses, create industries and open new markets. Moreover, it has led to new products and services that save lives, reduce suffering and improve our quality of life. From diagnostic tests for cancer to guardrails on our roadways to improved modems on the communications superhighway, technology transfer is enhancing the way we live and work.

How does the public benefit from university-industry partnerships?

University-industry partnerships are helping to move new discoveries from the laboratory to the marketplace faster and more efficiently than ever before -- ensuring that products and services reach the public more quickly and often. The partnership enables a researcher -- who made the initial discovery -- to participate in the further development of a product or process, which in turn

significantly reduces the time to eventual commercialization.

Industry not only contributes its own expertise to further development, it often commits financial resources to permit the university researcher to continue working on an idea. In the 1995 Survey, 76 universities attracted nearly \$113 million in new industry financial support as a direct result of licensing. This financial support increases the return on the federal government's initial investment in university research and ensures that research results are utilized. Finally, the licensing of innovations -- which forms the basis of many university-industry partnerships -- generates royalties for the universities, which are reinvested in the academic enterprise.

How do universities use the royalties earned from licensing?

Royalties earned by academic institutions are used to help advance scientific research and education through reinvestment in the academic enterprise. The royalties are given, in part, to university research departments to provide, among other things, new opportunities for graduate students, buy research equipment or fund new research. They also are used to help sustain the technology transfer process by paying for a portion of the legal fees associated with patenting and licensing as well as technology management staff. And finally, as the Bayh Dole Act requires, a portion of the revenues is shared with the university inventor.

What are some of the successes of technology transfer?

New discoveries at our nation's universities have been successfully transferred to help spawn the biotechnology industry and led to advances in the medical, engineering, chemical, computing and software industries, among others. Diagnostics tests for breast cancer and osteoporosis, faster modems, new Internet search engines, environmentally sound technologies and safer guardrails are just a few of the products that have been developed as a result of licensing university innovations.

How do universities measure success in technology transfer?

Technology transfer through licensing is a relatively new field, so reliable success indicators have not yet been established. However, measures used to date include: the number of inventions disclosed; the number of patent applications filed, patents issued and licenses consummated; the amount of licensing revenue, and the number of commercial products produced and sold. More intangible -- but certainly just as important -- measures of the success of technology transfer include a university's capability to retain entrepreneurial

faculty and attract outstanding graduate students; its reputation for innovation; the enhancement of university research; and, its reputation for providing highly trained students for the industrial workforce. The marketplace impact of university-originated products and technology is unquestionably a major component of success.

¹ *Rates of increase will vary, depending on a review of all respondents versus seven-year recurrent respondents.*